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Snyder

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(54) **WATER SAFETY MONITORING SYSTEMS AND RELATED METHODS**

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G08B 21/08 (2006.01)

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CPC ***G08B 21/08*** (2013.01); ***G08B 21/084*** (2013.01); ***G08B 21/086*** (2013.01); ***G08B 21/088*** (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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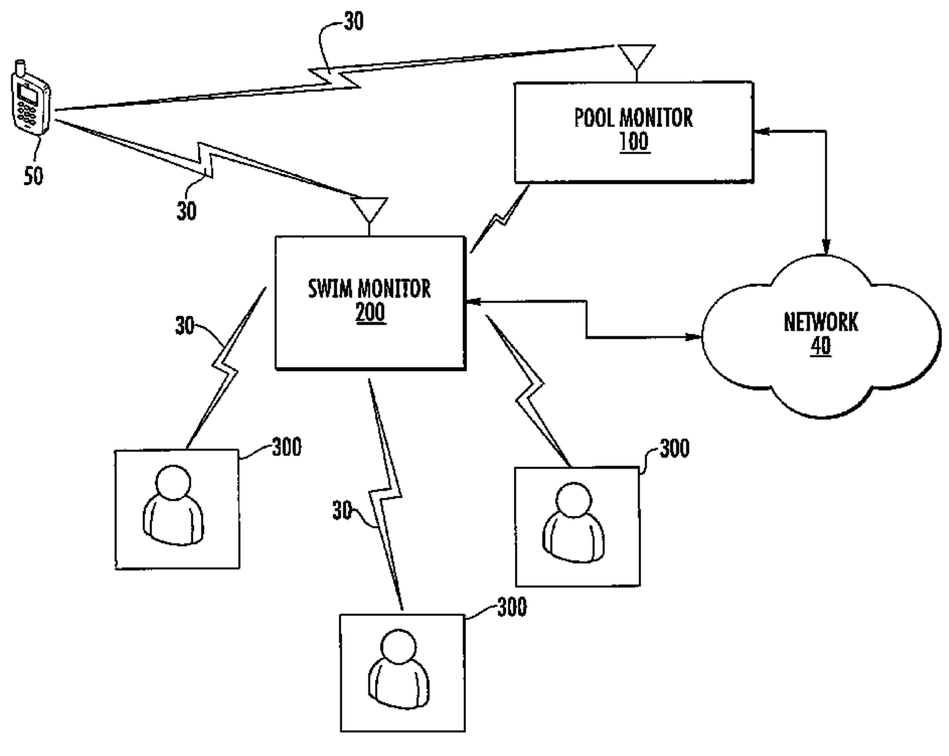
(57) **ABSTRACT**

A system for reducing a risk of drowning in a pool includes a pool monitoring unit and a swim monitoring station. The pool monitoring unit is switchable between an activated state and a deactivated state. The pool monitoring unit is configured to detect entrance into the pool and/or movement in the pool and to output an alarm signal in response a detected entrance into the pool and/or movement in the pool when in the activated state. The swim monitoring station is configured to wirelessly communicate with one or more wearable alarm devices and the swim monitoring station is in wireless communication with the pool monitoring unit. The swim monitoring station is switchable between an off state and an on state. In the on state, the swim monitoring station is configured send a wireless signal to the pool monitoring unit to deactivate the pool monitoring unit.

30 Claims, 8 Drawing Sheets



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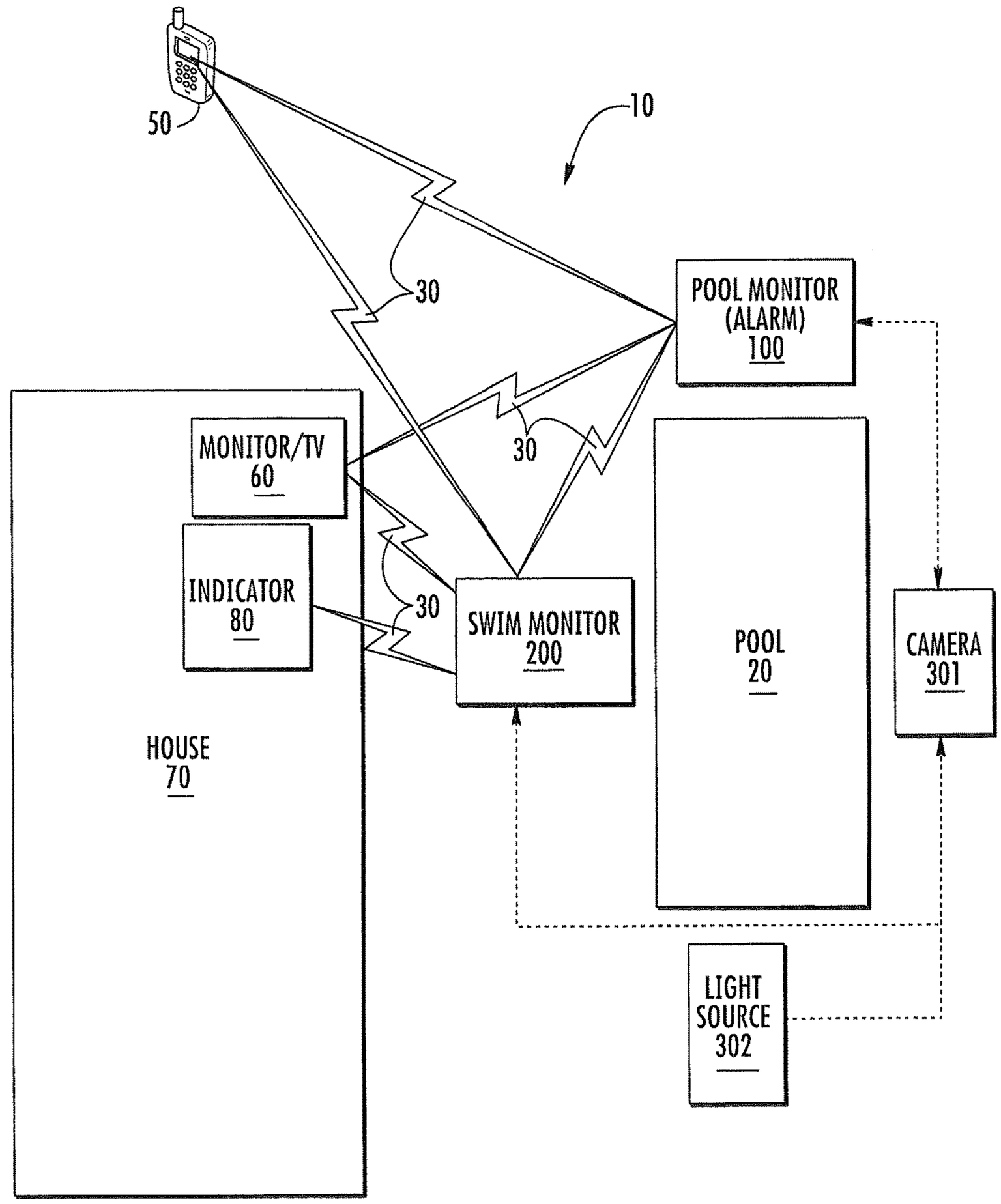
50
10
30
POOL MONITOR
(ALARM)
100
30
MONITOR/TV
60
INDICATOR
80
30
SWIM MONITOR
200
POOL
20
CAMERA
301
HOUSE
70
LIGHT
SOURCE
302

FIG. 1

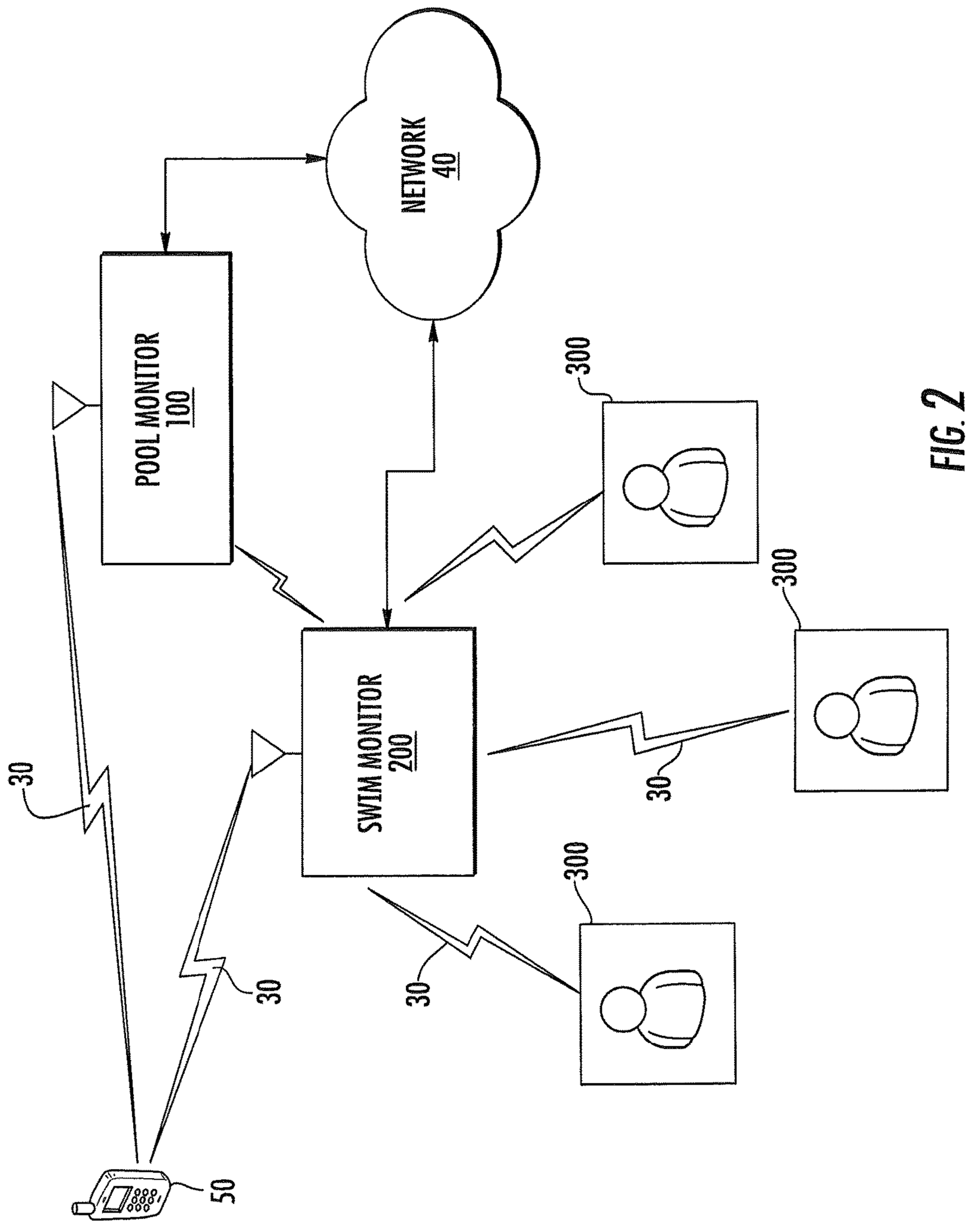
NETWORK
40
POOL MONITOR
100
SWIM MONITOR
200
300
300
300
30
30
30
30
50

FIG. 2

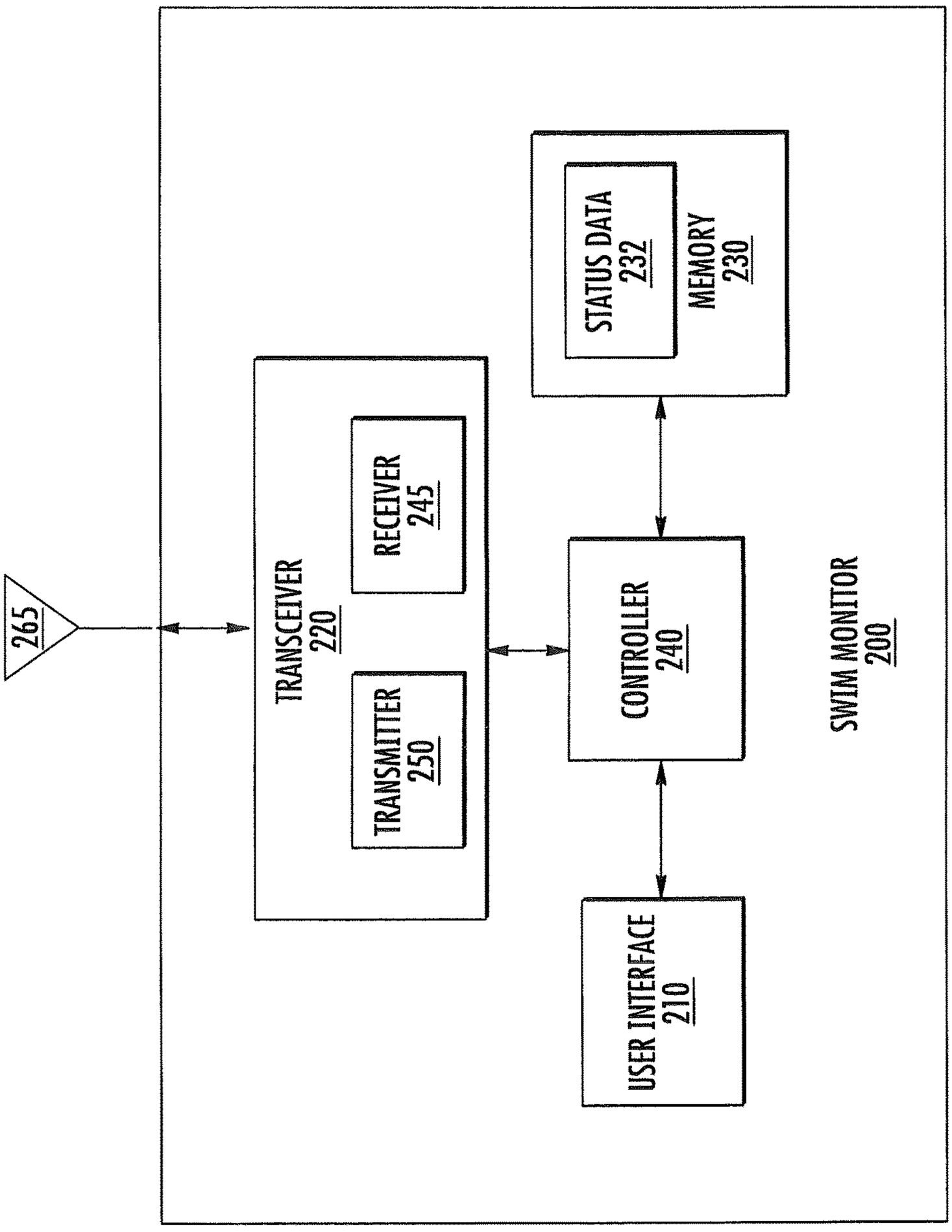
265
TRANSCEIVER
220
TRANSMITTER
250
RECEIVER
245
CONTROLLER
240
STATUS DATA
232
MEMORY
230
USER INTERFACE
210
SWIM MONITOR
200

FIG. 3

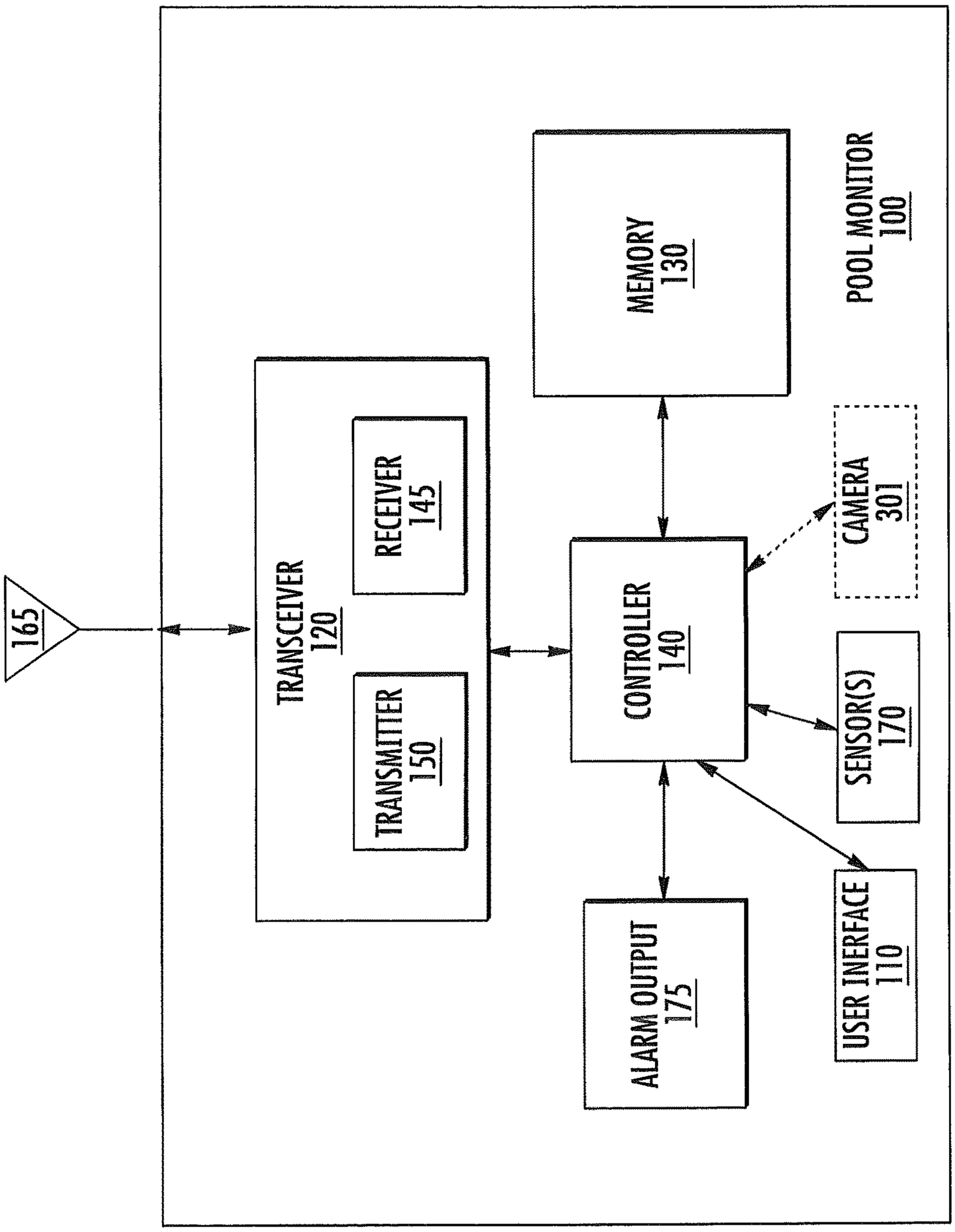
165
TRANSCEIVER 120
TRANSMITTER 150
RECEIVER 145
CONTROLLER 140
MEMORY 130
CAMERA 301
SENSOR(S) 170
ALARM OUTPUT 175
USER INERFACE 110
POOL MONITOR 100

FIG. 4

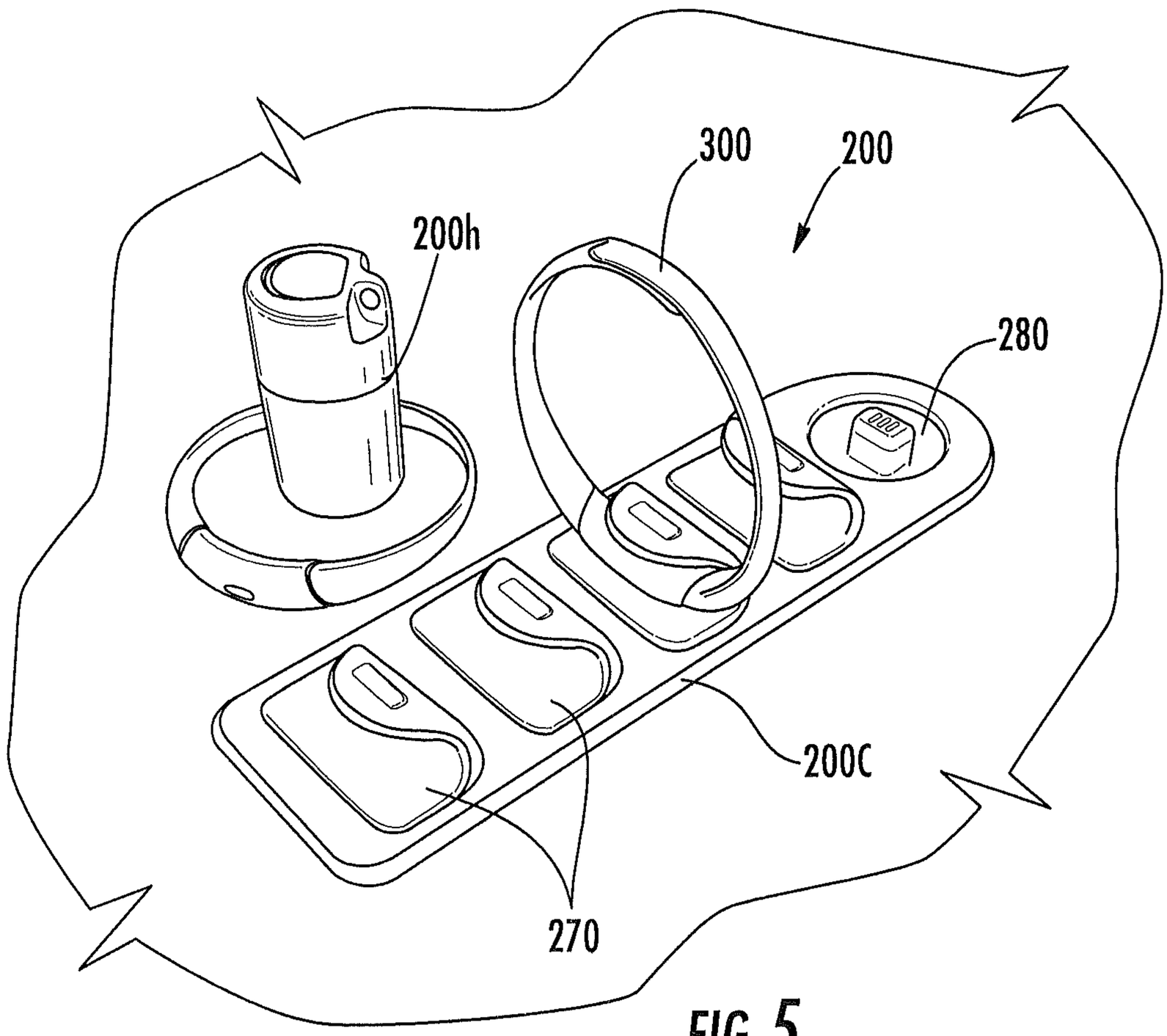

FIG. 5

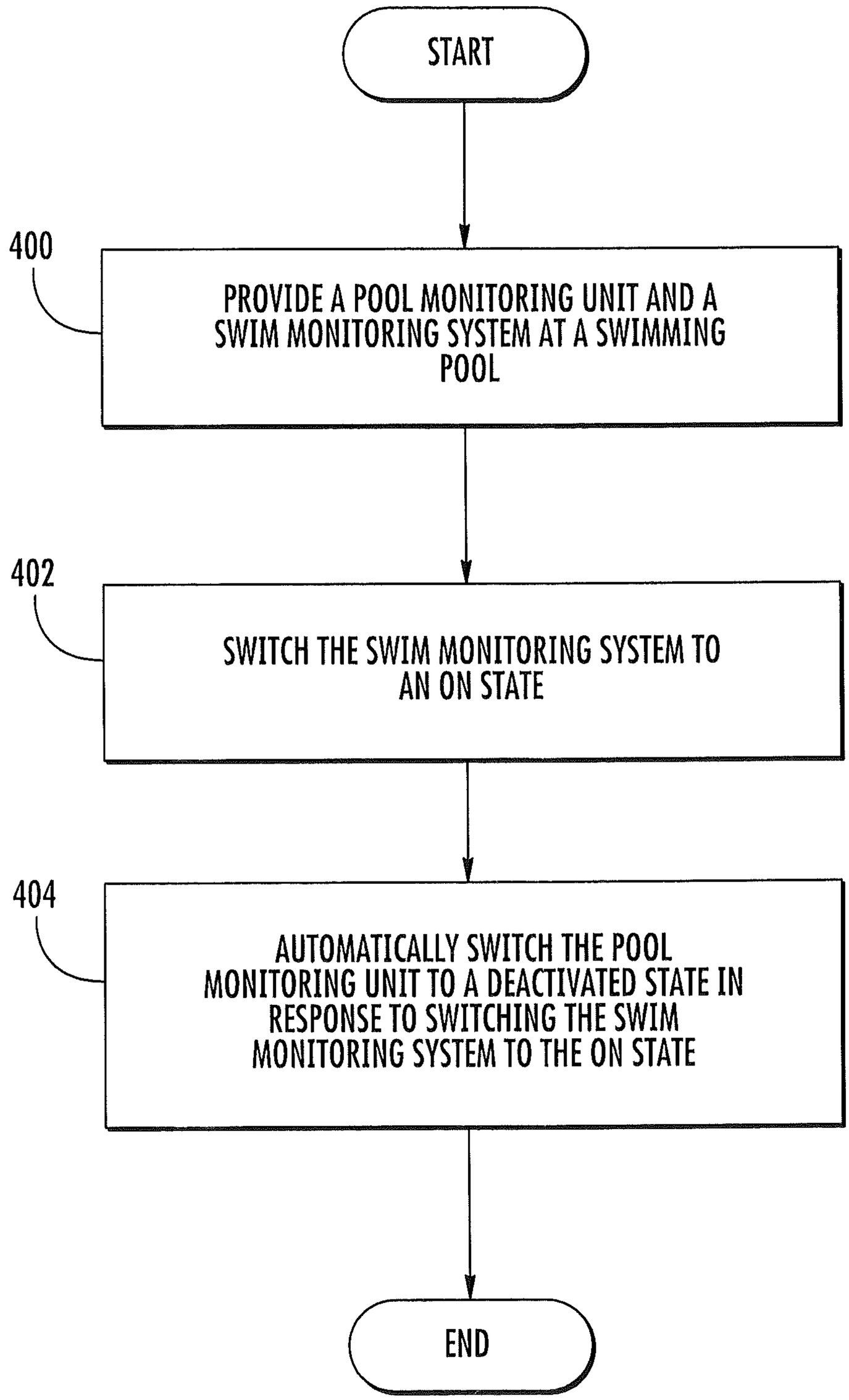
START
400
PROVIDE A POOL MONITORING UNIT AND A SWIM MONITORING SYSTEM AT A SWIMMING POOL
402
SWITCH THE SWIM MONITORING SYSTEM TO AN ON STATE
404
AUTOMATICALLY SWITCH THE POOL MONITORING UNIT TO A DEACTIVATED STATE IN RESPONSE TO SWITCHING THE SWIM MONITORING SYSTEM TO THE ON STATE
END

FIG. 6

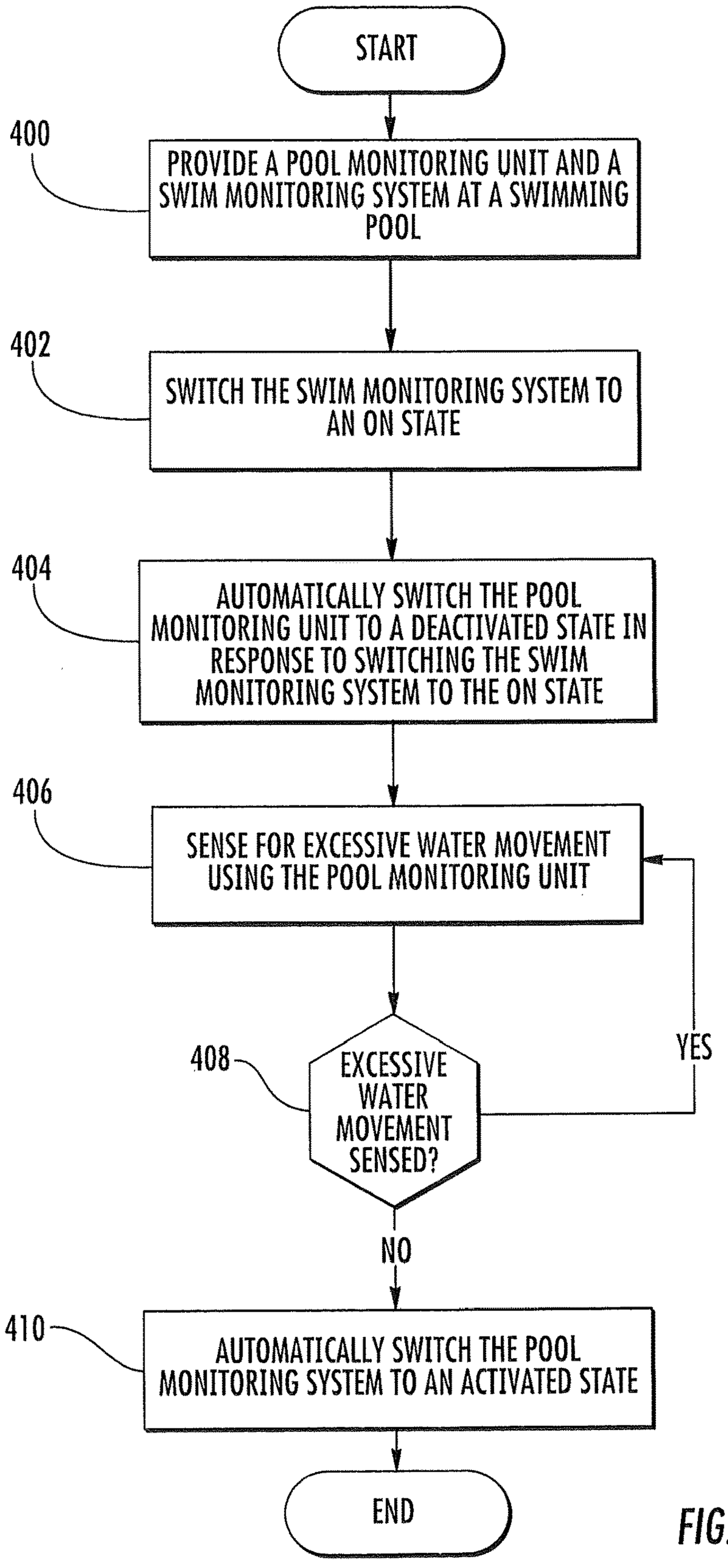
START
400
PROVIDE A POOL MONITORING UNIT AND A SWIM MONITORING SYSTEM AT A SWIMMING POOL
402
SWITCH THE SWIM MONITORING SYSTEM TO AN ON STATE
404
AUTOMATICALLY SWITCH THE POOL MONITORING UNIT TO A DEACTIVATED STATE IN RESPONSE TO SWITCHING THE SWIM MONITORING SYSTEM TO THE ON STATE
406
SENSE FOR EXCESSIVE WATER MOVEMENT USING THE POOL MONITORING UNIT
408
EXCESSIVE WATER MOVEMENT SENSED?
YES
NO
410
AUTOMATICALLY SWITCH THE POOL MONITORING SYSTEM TO AN ACTIVATED STATE
END

FIG. 7

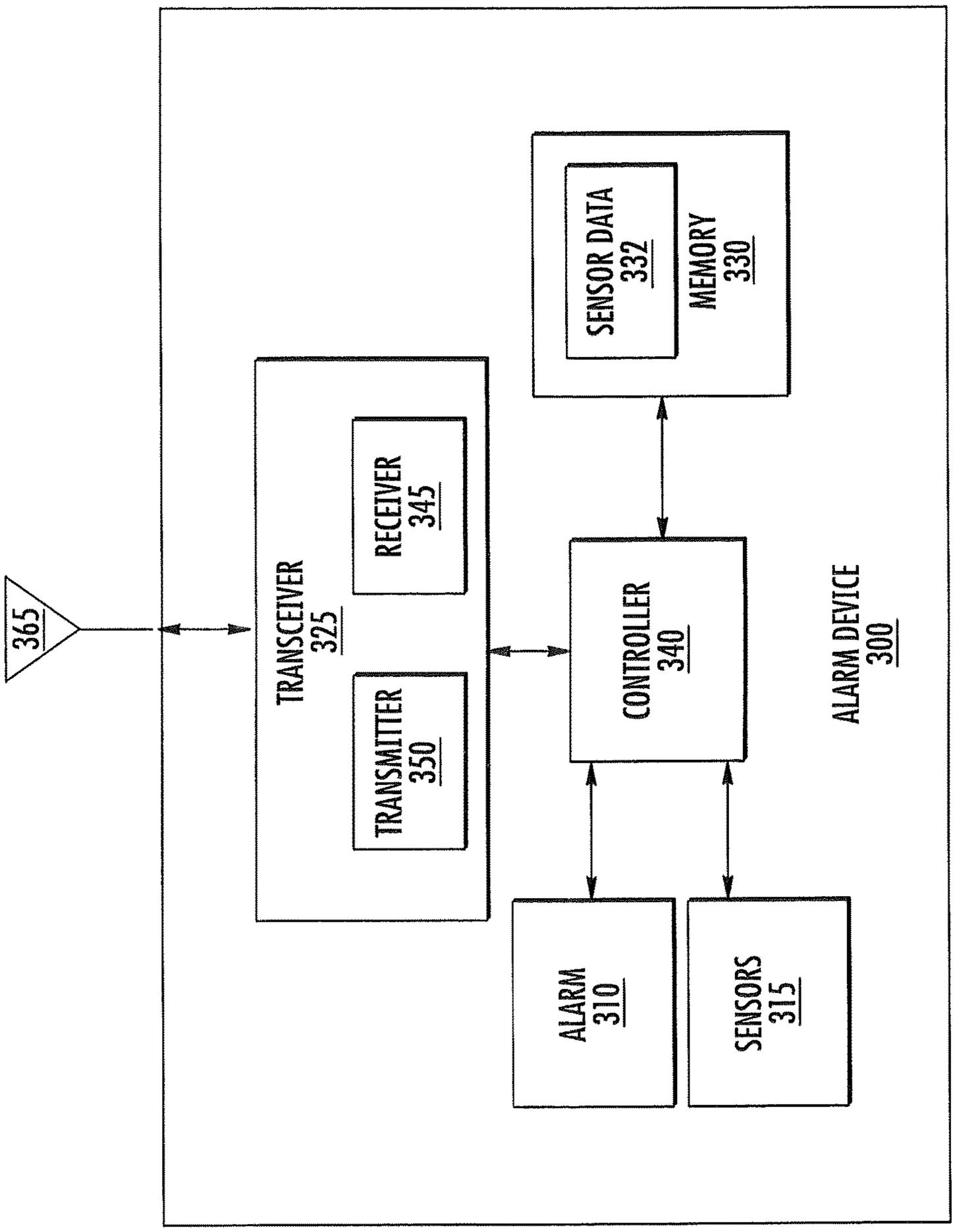
365
TRANSCEIVER
325
TRANSMITTER
350
RECEIVER
345
CONTROLLER
340
SENSOR DATA
332
MEMORY
330
ALARM DEVICE
300
ALARM
310
SENSORS
315

FIG. 8

WATER SAFETY MONITORING SYSTEMS AND RELATED METHODS

RELATED APPLICATIONS

The present application is a 35 U.S.C. § 371 national phase application of PCT International Application No. PCT/US2014/046133, filed Jul. 10, 2014, which claims priority to U.S. Provisional Application Ser. No. 61/844,543, filed Jul. 10, 2013, the disclosures of which are hereby incorporated herein by reference in their entirety. PCT International Application No. PCT/US2014/046133 is published in English as PCT Publication No. WO 2015/006551.

BACKGROUND

Drowning remains a significant cause of accidental deaths, especially among children. Many children are non-swimmers and die as a result of falling into swimming pools; however, many children and adults who are swimmers die either from panic, exhaustion, cramps, seizures or a combination thereof. Children may drown despite being supervised while swimming. The parents or other adults supervising the child may have "just looked away for a second" only to find the child drowned on the bottom of the pool.

Several attempts have been made to address water safety with various degrees of success. One approach taken to prevent drowning is to place an alarm on the pool itself. Exemplary pool alarms are Poolguard® Models PGRM-2 and PGRM-SB available from PBM Industries, Inc. (North Vernon, Ind.). With such pool alarms, an audible alert sounds when a sensor detects entrance into the pool (e.g., due to movement of the water). Pool alarms may be useful if the pool is empty, but are not suited for use with a child who is allowed to play in the pool. Furthermore, the alarm is deactivated when swimming is allowed, and there is a risk that the user may forget or neglect to reactivate the alarm after the swimming session.

Monitoring systems that use wearable alarm devices can provide significant enhancements over pool alarms. For example, wearable swim monitors and drowning detection systems may track the swimmer in the water and identify possible drowning events. However, these systems may be limited in the sense that the swimmer or supervisor must proactively attach the wearable alarm device to the swimmer's body; if the device is not attached, the swimmer will not be protected.

SUMMARY

According to some embodiments of the present invention, a system for reducing a risk of drowning in a pool is provided. The system includes a pool monitoring unit and a swim monitoring station. The pool monitoring unit is switchable between an activated state and a deactivated state. The pool monitoring unit is configured to detect entrance into the pool and/or movement in the pool and to output an alarm signal in response a detected entrance into the pool and/or movement in the pool when in the activated state. The swim monitoring station is configured to wirelessly communicate with one or more wearable alarm devices. The swim monitoring station is in wireless communication with the pool monitoring unit. The swim monitoring station is switchable between an off state and an on state. In the on state, the swim monitoring station is configured send a wireless signal to the pool monitoring unit to deactivate the pool monitoring unit.

The swim monitoring station may be configured to receive an input and, in response, switch to the on state. The swim monitoring station may include a user interface configured to receive the input from a user.

In some embodiments, the swim monitoring station is adapted to releasably hold the one or more wearable alarm devices. The swim monitoring station may be in the off state when each wearable alarm device is held by the monitoring station. In some embodiments, each wearable alarm device is configured to releasably connect to a user and, in response, send a connect signal to the swim monitoring station. The swim monitoring station may be configured to switch to the on state when one of the wearable alarm devices is removed from the swim monitoring station and sends the connect signal.

At least one of the pool monitoring unit and the swim monitoring station may be switchable to a safe mode. In some embodiments, in the safe mode, the swim monitoring station is not switchable to the on state and/or the pool monitoring unit is not switchable to the deactivated state.

In some embodiments, each one of the pool monitoring unit and the swim monitoring station is configured to receive a periodic signal from the other one of the pool monitoring unit and the swim monitoring station. The pool monitoring unit may not be switchable to the deactivated state when the periodic signal is not received at one of the pool monitoring unit and the swim monitoring station. The pool monitoring unit may automatically switch to the activated state when the periodic signal is not received at one of the pool monitoring unit and the swim monitoring station.

The system may include at least one camera at the pool. The camera may be configured to capture photographs and/or video. The camera or a controller associated therewith may be configured to send video feed signals and/or multimedia messaging service (MMS) messages to one or more outside devices. The one or more outside devices may include one or more video monitors and/or mobile communication devices.

In some embodiments, the camera or a controller associated therewith is configured to send video signals and/or MMS messages to the one or more outside devices when the pool monitor unit is in the activated state and an entrance into the pool and/or movement in the pool is detected. The camera or a controller associated therewith may be configured to send video signals and/or MMS messages to the one or more outside devices when the swim monitor station is in the on state. The camera or a controller associated therewith may be configured to send video signals and/or MMS messages to the one or more outside devices when the swim monitor station is in the on state and an alarm condition associated with one of the wearable alarm devices is detected.

The system may include at least one light source. The light source may be configured to illuminate the pool area while the camera captures photographs and/or video. The at least one camera and/or at least one light source may be positioned and configured to provide video and/or MMS messages from below a water surface of the pool. In some embodiments, the camera is configured to detect motion or movement around the pool and/or below a water surface of the pool, and the camera or a controller associated therewith is configured to send a signal to activate the pool monitoring unit when motion or movement is detected and then not detected for a predetermined period of time.

In some embodiments, at least one of the pool monitor unit and the swim monitor station is configured to send short message service (SMS) messages to one or more mobile

communication devices. The SMS message(s) may be sent when the pool monitor unit is in the activated state and an entrance into the pool and/or movement in the pool is detected. The SMS message(s) may be sent when the swim monitor station is switched to the on state. The SMS message(s) may be sent when the swim monitor station is in the on state and an alarm condition associated with one of the wearable alarm devices is detected.

In some embodiments, at least one of the pool monitor unit and the swim monitor station is configured to autodial one or more telecommunication devices and play a prerecorded message.

In some embodiments, the pool monitor unit is configured to automatically switch to the activated state after the swim monitor station has switched to the on state and a predetermined period of time has elapsed without the swim monitoring station having received a wireless signal from one of the wearable alarm devices.

In some embodiments, the pool monitor unit is configured to detect a level of movement of water in the pool regardless of whether the pool monitor unit is in the activated or deactivated state. The pool monitor unit may be configured to automatically switch from the deactivated state to the activated state after a predetermined period of time has elapsed without detection the level of movement of the water in the pool. In some embodiments, the pool monitor unit is configured to detect a level of movement of water in the pool, and the pool monitor unit is configured to automatically switch to the activated state after the swim monitor station has switched to the on state and a predetermined period of time has elapsed without the swim monitor station having received a wireless signal from at least one of the wearable alarm devices indicating that the at least one wearable alarm devices is moving and/or wet.

According to some other embodiments of the present invention, a water safety monitoring system is provided. The system includes one or more wearable monitoring devices and a pool alarm unit. The pool alarm unit is configured to deactivate when at least one of the wearable monitoring devices is connected to a user.

According to some other embodiments of the present invention, a method includes providing a pool monitoring unit and a swim monitoring system at a swimming pool. The pool monitoring unit is switchable between an activated state and a deactivated state. The swim monitoring system is in wireless communication with the pool monitoring unit. The swim monitoring system is switchable between an on state and an off state. The method includes switching the swim monitoring system to the on state. The method includes automatically switching the pool monitoring unit to the deactivated state in response to switching the swim monitoring system to the on state.

In some embodiments, the method includes sensing for excessive water movement in the swimming pool using the pool monitoring unit. The method may include outputting an alarm signal using the pool monitoring unit when the pool monitoring unit is in the activated state and excessive water movement is sensed. The method may include automatically switching the pool monitoring unit to the activated state when the pool monitoring unit is in the deactivated state and excessive water movement is not sensed over a predetermined length of time.

In some embodiments, the step of switching the pool monitoring unit to the deactivated state in response to switching the swim monitoring system to the on state includes sending a deactivate signal from the swim monitoring system to the pool monitoring unit.

The method may include wirelessly sending an announcement to one or more outside devices using one of the pool monitoring unit and the swim monitoring system.

In some embodiments, the method includes streaming video captured by a camera at the swimming pool to a monitor that is situated away from the swimming pool.

It is noted that any one or more aspects or features described with respect to one embodiment may be incorporated in a different embodiment although not specifically described relative thereto. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination. Applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to be able to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner. These and other objects and/or aspects of the present invention are explained in detail in the specification set forth below.

BRIEF DESCRIPTION OF THE FIGURES

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain principles of the invention.

FIG. **1** is a schematic drawing illustrating a pool safety system having a pool monitoring unit and a swim monitoring station according to some embodiments of the present invention.

FIG. **2** is a schematic drawing illustrating a pool monitoring unit, a swim monitoring station and a plurality of wearable alarm devices according to some embodiments of the present invention.

FIG. **3** is a block diagram of a swim monitoring station according to some embodiments of the present invention.

FIG. **4** is a block diagram of a pool monitoring unit according to some embodiments of the present invention.

FIG. **5** is an illustration of a pool monitoring station configured to releasably hold a plurality of wearable alarm devices according to some embodiments of the present invention.

FIGS. **6** and **7** are flowcharts illustrating operations according to some embodiments of the present invention.

FIG. **8** is a block diagram of a user alarm device according to some embodiments of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The present invention now will be described hereinafter with reference to the accompanying drawings and examples, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

Like numbers refer to like elements throughout. In the figures, the thickness of certain lines, layers, components, elements or features may be exaggerated for clarity.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will

be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. As used herein, phrases such as "between X and Y" and "between about X and Y" should be interpreted to include X and Y. As used herein, phrases such as "between about X and Y" mean "between about X and about Y." As used herein, phrases such as "from about X to Y" mean "from about X to about Y."

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the specification and relevant art and should not be interpreted in an idealized or overly formal sense unless expressly so defined herein. Well-known functions or constructions may not be described in detail for brevity and/or clarity.

It will be understood that when an element is referred to as being "on," "attached" to, "connected" to, "coupled" with, "contacting," etc., another element, it can be directly on, attached to, connected to, coupled with or contacting the other element or intervening elements may also be present. In contrast, when an element is referred to as being, for example, "directly on," "directly attached" to, "directly connected" to, "directly coupled" with or "directly contacting" another element, there are no intervening elements present. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

Spatially relative terms, such as "under," "below," "lower," "over," "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of "over" and "under." The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Similarly, the terms "upwardly," "downwardly," "vertical," "horizontal" and the like are used herein for the purpose of explanation only unless specifically indicated otherwise.

It will be understood that, although the terms "first," "second," etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. Thus, a "first" element discussed below could also be termed a "second" element without departing from the teachings of the present invention. The sequence of operations (or steps) is not limited to the order presented in the claims or figures unless specifically indicated otherwise.

Exemplary embodiments are described below with reference to block diagrams and/or flowchart illustrations of computer-implemented methods, apparatus (systems and/or devices) and/or computer program products. It is understood that a block of the block diagrams and/or flowchart illustrations, and combinations of blocks in the block diagrams and/or flowchart illustrations, can be implemented by computer program instructions that are performed by one or more computer circuits. These computer program instructions may be provided to a processor circuit of a general purpose computer circuit, special purpose computer circuit, and/or other programmable data processing circuit to produce a machine, such that the instructions, which execute via the processor of the computer and/or other programmable data processing apparatus, transform and control transistors, values stored in memory locations, and other hardware components within such circuitry to implement the functions/acts specified in the block diagrams and/or flowchart block or blocks.

These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including instructions which implement the functions/acts specified in the block diagrams and/or flowchart block or blocks.

The computer-usable or computer-readable medium may be, for example but not limited to, an electronic, magnetic, optical, electromagnetic, or semiconductor data storage system, apparatus, or device. More specific examples (a non-exhaustive list) of the computer-readable medium would include the following: a portable computer diskette, a random access memory (RAM) circuit, a read-only memory (ROM) circuit, an erasable programmable read-only memory (EPROM or Flash memory) circuit, a portable compact disc read-only memory (CD-ROM), and a portable digital video disc read-only memory (DVD/BlueRay). It should also be noted that in some alternate implementations, the functions/acts noted in the blocks may occur out of the order noted in the flowcharts. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved. Moreover, the functionality of a given block of the flowcharts and/or block diagrams may be separated into multiple blocks and/or the functionality of two or more blocks of the flowcharts and/or block diagrams may be at least partially integrated.

Generally speaking, embodiments of the present invention integrate a pool monitoring system (e.g., swimming pool alarm) and a swim monitoring system that employs one or more wearable body monitors. The pool monitoring system and swim monitoring system cooperate to provide enhanced pool safety.

A water safety monitoring system **10** for use with a swimming pool **20** is illustrated in FIG. **1**. The system **10** includes a pool monitoring device or unit **100** (e.g., a pool alarm) and a swim monitoring device, system or station **200**. The pool monitoring unit **100** is switchable between an activated state and a deactivated state. In the activated state, the pool monitoring unit **100** may be configured to detect entrance into the pool **20** and/or movement in the pool **20** and output an alarm signal in response to a detected entrance into the pool **20**. In some embodiments, the pool monitoring unit **100** is configured to detect motion and/or movement around the pool **20** and/or in the pool **20** (e.g., underwater motion).

The pool monitoring unit **100** has a wireless communication link **30** with the swim monitoring station **200**. The swim monitoring station **200** is switchable between an off state and an on state. When switched to the on state, the swim monitoring station **200** is configured to send a wireless signal to the pool monitoring unit **100** to deactivate the pool monitoring unit **100**, as will be described in more detail below.

As illustrated in FIG. **2**, the swim monitoring station **200** has wireless communication links **30** with one or more wearable user alarm devices **300**. A water safety monitoring system including the swim monitoring station **200** and the alarm devices **300** is described in detail in co-owned and co-pending U.S. application Ser. No. 13/587,488, filed Aug. 16, 2012, and published as U.S. Patent Application Publication No. 2014/0049394, the disclosure of which is hereby incorporated by reference in its entirety. As described in U.S. application Ser. No. 13/587,488, the swim monitoring station **200** is configured to receive status data from the one or more wearable alarm devices **300** and is configured to detect a triggering event. In response to the triggering event, the swim monitoring station **200** is configured to select an alarm protocol (e.g., a drowning alarm or a concern alarm). The alarm protocol may include visual, audible and/or vibration alarms to alert a lifeguard or other caretaker that one of the alarm devices **300** is indicating an event of serious concern (e.g., a drowning alarm) and/or is indicating an event of perhaps less serious concern (e.g., a concern alarm).

The user alarm device **300** may be configured as a necklace or other wearable device. Suitable alarm device configurations are discussed and illustrated in U.S. application Ser. No. 13/587,488 and Ser. No. 29/460,466 entitled "Monitoring Band" (allowed and pending issuance) as well as co-owned U.S. Pat. No. 7,554,453, the disclosures of which are hereby incorporated by reference in their entireties.

As illustrated in FIG. **3**, the swim monitoring station **200** may include a user interface **210**, a transceiver **220**, a memory **230** and a controller **240**. The transceiver **220** may be a wireless transceiver and may include a receiver **245** and a transmitter **250**, which may be coupled to an antenna **265**. The transceiver **220** is configured to establish a wireless connection, e.g., with the pool monitoring unit **100**, the alarm devices **300**, the network **40** (FIG. **2**) and/or one or more outside devices **50**, **60** (FIG. **1**).

As illustrated in FIG. **8**, the alarm device **300** includes an alarm indicator **310**, sensors **315**, a transceiver **320**, a memory **330** and a controller **340**. The transceiver **320** may be a wireless transceiver and may include a receiver **345** and a transmitter **350**, which may be coupled to an antenna **365**. In some embodiments, the wireless connection between the monitoring station **200** and the alarm devices **300** is a radio frequency (RF) connection; however, any suitable wireless connection may be used, including cellular telephone connections, a Bluetooth® connection, a wireless local area network connection (e.g., 802.11), ultrasonics and the like. In some embodiments, the wireless connection between the swim monitoring station **200** and one or more of the other components (e.g., the pool monitoring unit **100** and/or the outside devices **50**, **60**) is a radio frequency (RF) connection; however, any suitable wireless connection may be used, including cellular telephone connections, a Bluetooth® connection, a wireless local area network connection (e.g., 802.11), ultrasonics and the like.

As illustrated in FIG. **1**, status updates, including data from the sensors **315** and/or position information for the devices **300**, may be communicated by the alarm devices **300** to the monitoring station **200** and may be stored as status data **232** in the memory **230**. If a triggering event occurs, such as a loss of communication, the monitoring station **200** selects one of a plurality of alarm protocols. The alarm protocol is conveyed to a user, for example, on the user interface **210** illustrated in FIG. **3**. The user interface **210** of the monitoring station **200** may be any suitable user interface, such as a touch sensitive screen, a keypad, a joystick or other user interface and may include display features for displaying information (e.g., a display screen or an indicator light for a given alarm level), a speaker for indicating an auditory alarm, and/or a vibration feature for vibrating a mobile alarm **202**. Accordingly, the user interface **210** is configured to communicate alarm information through any suitable user interface.

The sensors **315** of the alarm device **300** may include sensors for detected environmental conditions of the alarm device **300**. For example, the sensors **315** may include accelerometers, moisture/water sensors, temperature sensors, position sensors, inductive capacitance sensors, ultraviolet radiation sensors, depth gauges and the like for detecting whether the device **300** is wet, dry, moving, or still. In particular embodiments, a charging port may also be configured as a sensor **315** so that when the charging port having two electrical terminals is wet, the corresponding change in conductivity between the charging ports secondary to water and not air bridging the contacts is detected by the device **300**. In some embodiments, the sensor **315** may provide data as a state (e.g., wet or dry, moving or still); however, a quantitative value may also be measured by the sensors **315** (e.g., velocity, location, distance from the monitoring device **200**, and the like). The memory **330** may include data, such as sensor data **332**, including information recorded by the sensors **315** regarding the environmental conditions of the alarm device **300**.

As illustrated in FIG. **4**, the pool monitoring unit **100** may include a user interface **110**, a transceiver **120**, a memory **130** and a controller **140**. The transceiver **120** may be a wireless transceiver and may include a receiver **145** and a transmitter **150**, which may be coupled to an antenna **165**. The transceiver **120** is configured to establish a wireless connection, e.g., with the swim monitoring station **200**, the network **40** (FIG. **2**) and/or one or more outside devices **50**, **60** (FIG. **1**). As noted above, the pool monitoring unit **100** and the swim monitoring station **200** may be configured to communicate data therebetween over a direct wireless communication interface or over another wireless communication interface through another device, such as a cellular base station or wireless local area network (WLAN) router.

The pool monitoring unit **100** includes one or more sensors **170** and one or more alarm output devices **175**. At least one sensor **170** may be in communication with or directed toward the water in the swimming pool **20** (FIG. **1**) such that the sensor can detect excessive water movement, which may be indicative of an entrance into the swimming pool **20**. At least one sensor **170** may be directed toward a perimeter of the swimming pool **20** and/or toward an entrance of the swimming pool **20** to detect movement near the swimming pool **20** by a child or an unauthorized person. In some embodiments, at least one sensor **170** and/or at least one camera **301** may be positioned and configured to detect motion or movement below a water surface of the pool **20**, as described in more detail below. Generally speaking, the pool monitoring unit **100** may be configured for wave, motion or sound detection. For example, the pool monitoring unit **100** may detect motion by: infrared (e.g., Passive and active sensors); Optics (e.g., video and camera systems);

Radio Frequency Energy (e.g., radar, microwave and tomographic motion detection); Sound (e.g., using microphones and acoustic sensors); Vibration (e.g., triboelectric, seismic, and inertia-switch sensors); and Magnetism (e.g., magnetic sensors and magnetometers). In response to a detected entrance or movement, the sensor **170** and/or the controller **140** may send an alarm signal to the alarm output device **175**, which may output an audible and/or visual alert at the pool monitoring unit **100**. Additionally or alternatively, in response to a detected entrance or movement, the transceiver **120** may send an alarm signal or other alert to one or more outside devices, as will be described in greater detail below. The pool monitoring unit **100** will typically only provide alarm signals when in the activated state.

As noted above, when switched to the on state, the swim monitoring station **200** is configured to send a wireless signal to the pool monitoring unit **100** to deactivate the pool monitoring unit **100**. For example, the swim monitoring station **200** may switch to the on state when one of the wearable alarm devices **300** is attached or connected to a user. The wearable alarm device **300** may send a connect signal to the swim monitoring station **200**, which may in turn send a deactivate signal to the pool monitoring unit **100**. Alternatively, the wearable alarm device **300** may be configured to wirelessly communicate with the pool monitoring unit **100** and to send a connect/deactivate signal to the pool monitoring unit **100**.

In some embodiments, and as illustrated in FIG. **5**, the swim monitoring station **200** may include a charging station **200***c* having recharging outlets **270** such that a plurality of user alarm devices **300** may be recharged at the monitoring station **200**. Each outlet **270** is configured to releasably hold one of the alarm devices **300**, and the swim monitoring station **200** may be configured to detect or sense when one of the alarm devices **300** has been removed from a respective one of the outlets **270**. In some embodiments, the swim monitoring station **200** is configured to detect or sense that an alarm device **300** has been removed from one of the outlets **270** and thereafter receive a connect signal from the alarm device **300** indicating that the alarm device **300** has been attached or connected to a user. The swim monitoring station **200** may then switch to the on state and send a deactivate signal to the pool monitoring unit **100**.

In some embodiments, and as illustrated in FIG. **5**, the charging station **200***c* may include an outlet **280** configured to releasably receive a monitoring hub **200***h*. The hub **200***h* may include at least some of the components illustrated in FIG. **3**. Thus, in some embodiments, the hub **200***h* may carry out at least some of the functionality of the swim monitoring station **200** described herein.

The swim monitoring station **200** may be configured to receive an input and, in response, switch to the on state. For example, the input may include sensing that one of the alarm devices **300** has been removed from the charging station **200***c* and/or receiving a connect signal from the wearable alarm device **300** indicating that the alarm device **300** has been attached or connected to a user's body. The user interface **210** of the swim monitoring station **200** may also be configured to receive a user input, with the input necessary to switch the swim monitoring station **200** to the on state. For example, the user interface **210** may include a touch sensitive display or a keypad configured to receive a passcode as the user input. The user interface **210** may also include instrumentation for fingerprint recognition, retinal recognition, voice recognition or the like to recognize authorized users as the user input. Other configurations are contemplated; for example, the user interface **210** may be configured to recognize a magnetic strip from an authorized user card, to recognize an authorized RFID tag and so forth.

In some embodiments, the swim monitoring station **200** may only be turned to the on state after an input is received at the user interface **210** and one of the wearable alarm devices **300** is connected to a user. In some embodiments, the user interface **210** is used to receive input and to allow time for a user to disconnect the wearable alarm device **300** and return it to the charging station **200***c* such that the pool monitoring unit **100** does not reactivate immediately upon the user disconnecting the wearable alarm device **300**.

At least one of the pool monitoring unit **100** and the swim monitoring station **200** may be placed in a safe mode. In the safe mode, the pool monitoring unit **100** is not switchable to the deactivated state and/or the swim monitoring station **200** is not switchable to the on state. The user interface of the pool monitoring unit **100** and/or the swim monitoring station **200** may be used to place the pool monitoring unit **100** and/or the swim monitoring station **200** in the safe mode. In some embodiments, the pool monitoring unit **100** and/or the swim monitoring station **200** may receive a signal from the outside device **50** such that the pool monitoring unit **100** and/or the swim monitoring station **200** may be remotely placed in the safe mode.

In some embodiments, one of the pool monitoring unit **100** and the swim monitoring station **200** is configured to receive a continuous or a periodic signal from the other one of the pool monitoring unit **100** and the swim monitoring station **200**. If the signal is not received after a predetermined amount of time, the pool monitoring unit **100** may automatically switch to the activated state if in the deactivated state or may be prevented from being switched to the deactivated state if the in activated state. Loss of detection of the continuous or periodic signal may indicate a problem with one of the transceivers, may indicate that the pool monitoring unit **100** and/or the swim monitoring station **200** is low on power, or may indicate some other issue that could compromise safety.

When the swim monitoring station **200** is switched to the on state and the pool monitoring unit **100** is deactivated, the swim monitoring station **200** is configured to monitor the wearable alarm devices **300** and select an alarm protocol in response to a triggering event, as described in U.S. application Ser. No. 13/587,488. In some embodiments, if the swim monitoring station **200** detects a triggering event and selects an alarm protocol, the swim monitoring station **200** may automatically send an activate signal to the pool monitoring unit **100** to thereby activate the pool monitoring unit **100**. In this regard, were there to be a drowning or near-drowning event, the pool monitoring unit **100** would detect water motion and/or other movement and output an alarm signal to provide an extra layer of security and/or warning. In some embodiments, the swim monitoring station **200** may send an activate signal when the swim monitoring station **200** selects a drowning alarm indicating a higher risk of drowning, but perhaps not an alarm indicating a lower risk.

In some embodiments, the pool monitoring unit **100** may be configured to automatically switch to the activated state after the swim monitoring station **200** has switched to the on state and a predetermined amount of time has elapsed without the swim monitoring station **200** having received a signal from one of the wearable alarm devices **300**.

In some embodiments, if one of the wearable alarm devices **300** that was previously connected to a user becomes disconnected, the wearable alarm device **300** may send a disconnect signal to the swim monitoring station **200**.

In response, the swim monitoring station **200** may send an activate signal to the pool monitoring unit **100**. In some embodiments, upon disconnection of the wearable alarm device **300**, the wearable alarm device **300** may directly send an activate signal to the pool monitoring unit **100**.

As described above, the pool monitoring unit **100** may be configured to detect or sense movement of the pool water, for example movement beyond a threshold level. In some embodiments, the pool monitoring unit **100** is configured to detect or sense movement of the pool water regardless of whether the pool monitoring unit **100** is in the activated or deactivated state. The pool monitoring unit **100** may be configured to automatically switch from the deactivated state to the activated state after a predetermined period of time has elapsed without detection of significant movement of water (e.g., movement beyond a threshold level). This arrangement may allow for the pool monitoring unit **100** to automatically activate if, for example, the user forgot or neglected to activate pool monitoring unit **100** after a swimming session or if some other fault occurred.

In some embodiments, if the pool monitoring unit **100** detects or senses movement of the pool water while in the deactivated state but the swim monitoring station **200** does not receive a signal that one or more of the alarm devices **300** is moving and/or wet (e.g., for a threshold period of time), the pool monitoring unit **100** is configured to automatically switch from the deactivated state to the activated state (e.g., responsive to a signal from the swim monitoring station **200** that the one or more alarm devices **300** is not moving and/or wet). This arrangement may allow for the pool monitoring unit **100** to automatically activate if, for example, the user is in the pool but he or she is not wearing an alarm device **300**, the user removes the alarm device **300** and/or the monitoring station **200** or the alarm device **300** has malfunctioned.

In some embodiments, upon disconnection of the wearable alarm device **300**, the user or a supervisor may have a predetermined amount of time (e.g., 10 seconds) to perform a subsequent act to prevent the pool monitoring unit **100** from being activated right away. The act may include placing the wearable device **300** in the charging station **200***c*. The act may include "closing" the wearable device **300** such that it mimics the configuration when attached to a user. For example, the wearable device may have a latching mechanism that allows it to be connected around the user's neck. The user may unlatch the mechanism to disconnect the device **300** from his or her body and then latch the mechanism. The act may include a user input at the swim monitoring station **200** or the pool monitoring unit **100**, for example the user inputs performed at the user interface **210** described above in reference to switching the swim monitoring station **200** to the on state. Other acts are contemplated, including a combination of one or more of the acts just described.

Further, it may be desirable to provide a time delay before the pool monitoring unit **100** is "fully" reactivated after the wearable device **300** is disconnected from the user and/or the subsequent act is performed. There may be substantial movement of water in the swimming pool immediately after a swimming session. The delay before reactivation or full reactivation of the pool monitoring unit **100** may reduce the chance of the pool monitoring unit **100** outputting an alarm signal due to the water movement even though no one is in danger in the pool (i.e., the time delay may allow the water to calm before the pool monitoring unit **100** is reactivated). The time delay may be a predetermined amount of time (e.g., 5 minutes) and may be user adjustable, for example via the user interface **110** and/or **210**.

It is contemplated that the pool monitoring unit **100** may have a varying sensitivity to water movement beginning immediately after the wearable alarm device **300** is disconnected from the user and/or the subsequent act is performed. For example, immediately after the wearable alarm device **300** is disconnected from the user and/or the subsequent act is performed, the pool monitoring unit may tolerate relatively substantial water movement without outputting an alarm signal, and the tolerance for water movement may decay over time. This may allow for the pool monitoring unit **100** to be reactivated immediately, but also account for the water movement that will decrease over time after a swimming session. In some embodiments, motion or movement is detected around or in the pool (e.g., underwater) by the pool monitoring unit **100**. In such embodiments, it may not be necessary to provide a time delay before reactivating the pool monitoring unit **100**.

As noted above, the pool monitoring unit **100** and/or the swim monitoring station **200** may wirelessly communicate with one or more outside devices. As illustrated in FIGS. **1** and **2**, the one or more outside devices may include one or more portable electronic devices **50** such as cellular telephones, smartphones, tablet computers and the like. The pool monitoring unit **100** and/or the swim monitoring station **200** may send an announcement to the devices **50** when certain events occur.

An informational announcement may be sent when the pool monitoring unit **100** has been deactivated. For example, the pool monitoring unit **100** and/or the swim monitoring station **200** may be configured to send a short message service (SMS) message or the like to the devices **50** stating something along the lines of "Pool alarm deactivated but all is safe." The pool monitoring unit **100** and/or the swim monitoring station **200** may send periodic informational announcements such as "Swim monitoring system is active and all is safe."

An alert announcement may be sent when a more concerning event has occurred. For example, if the pool monitoring unit **100** outputs an alarm signal, the pool monitoring unit **100** and/or the swim monitoring station **200** may be configured to send a message to the devices **50** stating something like "Pool alarm signal detected!" If the swim monitoring station **200** detects a triggering event and selects an alarm protocol the pool monitoring unit **100** and/or the swim monitoring station **200** may be configured to send a message to the devices **50** stating something along the lines of "Swimmer in trouble!"

The pool monitoring unit **100** and/or the swim monitoring station **200** may also be configured to "autodial" the outside devices **50** and provide a similar prerecorded message instead of or in addition to the text message. The pool monitoring unit **100** and/or the swim monitoring station **200** may also be configured to autodial various other parties to provide the alert announcement. The other parties may include neighbors, 911, EMS, the fire department, home alarm monitoring company and so forth. As such, the alert announcement to the outside devices **50** may state something along the lines of "Pool alarm signal detected! Your neighbor and emergency personnel have been contacted" or "Swimmer in trouble! Your neighbor and emergency personnel have been contacted."

One or more cameras **301** may also be provided at or near the swimming pool **20**. In some embodiments, and as shown in FIG. **1**, the camera **301** may be a separate component. In this configuration, the camera **301** may capture photographs

and/or video and the camera **301** or a controller associated therewith may communicate the photographs and/or video (or data associated therewith) to the pool monitoring unit **100** and/or the swim monitoring station **200** (e.g., via a wired connection or wirelessly). The pool monitoring unit **100** and/or the swim monitoring station **200** may in turn provide the photographs and/or video to the outside devices **50**, **60**. Alternatively, the camera **301** may be configured to wirelessly communicate the photographs and/or video to the outside devices **50**, **60** (e.g., the camera may include a controller and a transmitter). In some embodiments, and as illustrated in FIG. **4**, the camera **301** may be included as part of the pool monitoring unit **100**, and the transceiver **120** may be configured to transmit the photographs and/or video captured by the camera **301**.

The camera **301** may be used for a variety of purposes. For example, the camera **301** may be configured to take photographs that may be sent to the outside devices **50** and/or the other parties as part of the announcements described above. The camera **301** or controller associated therewith may be configured to generate multimedia messaging service (MMS) messages or the like that may be used to provide a snapshot of the pool area along with the associated announcement. At least one camera **301** may be positioned and configured to detect motion or movement under a water surface of the pool. In this regard, the camera(s) may detect underwater motion or movement for the pool monitoring unit **100**.

Referring to FIG. **1**, the camera **301** may also be used to provide video signals to one or more monitors or televisions **60** that may be positioned inside and/or outside of home **70**. For example, the devices **60** may display video of the pool area at all times or when the swim monitor station **200** is in the on state during a swimming session. This arrangement may allow for children playing in the pool to always be in sight of caregivers (e.g., when the parents are going in and out of the house).

One or more light sources **302** (e.g., LED(s), light bulb(s) or other light sources) may be provided for nighttime photographs and/or video captured by the camera **301**. The light source **302** may be integrated with the camera **301** or otherwise be in communication with the camera **301**. In some embodiments, the camera **301** and the light source **302** are included as part of the pool monitoring unit **100**. In some embodiments, when the pool monitoring unit **100** is in the activated state, the light source(s) **302** is always on to provide lighting for the camera(s) **301** or other sensor(s) **170** to detect underwater motion or movement.

At least one camera **301** and/or light source **302** may be positioned and configured such that photographs and/or video may be captured underwater (i.e., beneath the water surface of the pool). The least one camera **301** and/or light source **302** may be always on or may be on when the pool monitoring unit **100** is in the activated state.

The camera **301** may be configured to detect motion or movement around the pool and/or underwater. In some embodiments, the pool monitoring unit **100** may be configured to switch from the deactivated state to the activated state if motion or movement stops or is not detected for a threshold period of time. For example, the pool monitoring unit **100** may switch from the deactivated state to the activated state responsive to a signal from the camera **301** or a controller associated therewith that motion or movement has stopped or has not been detected for a threshold period of time.

FIGS. **6** and **7** illustrate exemplary operations for enhanced water safety according to embodiments of the invention. Referring to FIG. **6**, the pool monitoring unit **100** and the swim monitoring system **200** are provided at a swimming pool (Block **400**). The swim monitoring system **200** is switched to the on state (Block **402**). The pool monitoring unit **100** automatically switches to the deactivated state in response to the swim monitoring system being switched to the on state (Block **404**).

Referring to FIG. **7**, the steps corresponding to Blocks **400**, **402** and **404** are included. The illustrated operation includes a further step of sensing for excessive water movement (e.g., movement past a certain threshold level) using the pool monitoring unit **100** while the pool monitoring unit **100** is in the deactivated state (Block **406**). If excessive movement is not sensed (Block **408**), then the pool monitoring unit **100** automatically switches to the activated state (Block **410**).

One or more indicator devices **80** may be provided in the house **70**. The indicator devices **80** may provide audible and/or visual alerts or indications when a certain event has occurred regarding the pool monitoring unit **100** and/or the swim monitoring station **200**. For example, the indicator device(s) **80** may illuminate and/or output an alarm when an alarm condition is detected from the pool monitoring unit **100** and/or the swim monitoring station **200**. The indicator device(s) **80** may wirelessly communicate with the pool monitoring unit **100** and/or the swim monitoring station **200** in the same way as described above in connection with the outside devices **50**, **60**.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

That which is claimed is:

1. A method comprising:

providing the following at a swimming pool:

a pool alarm that is switchable between an activated state and a deactivated state, the pool alarm configured to detect entrance into the pool and/or movement in the pool and to output an alarm signal in response to a detected entrance into the pool and/or movement in the pool when in the activated state;

one or more wearable alarm devices; and

a swim monitoring system in wireless communication with the one or more wearable alarm devices and with the pool alarm, the swim monitoring system being switchable between an on state and an off state;

switching the swim monitoring system from the off state to the on state;

automatically switching the pool alarm from the activated state to the deactivated state in response to switching the swim monitoring system from the off state to the on state by sending a wireless signal from the swim monitoring system to the pool alarm;

detecting a triggering event associated with the one or more wearable alarm devices; and

automatically switching the pool alarm from the deactivated state to the activated state in response to detecting the triggering event by sending a wireless signal from the swim monitoring system to the pool alarm.

2. The method of claim **1**, comprising:

sensing for excessive water movement in the swimming pool using the pool alarm; and

outputting an alarm signal using the pool alarm when the pool alarm is in the activated state and excessive water movement is sensed.

3. The method of claim **1**, comprising:

sensing for excessive water movement in the swimming pool using the pool alarm; and

automatically switching the pool alarm from the deactivated state to the activated state when the pool alarm is in the deactivated state and excessive water movement is not sensed over a predetermined length of time.

4. A system for reducing a risk of drowning in a pool, the system comprising:

a pool alarm, the pool alarm switchable between an activated state and a deactivated state, the pool alarm configured to detect entrance into the pool and/or movement in the pool and to output an alarm signal in response to a detected entrance into the pool and/or movement in the pool when in the activated state;

one or more wearable alarm devices; and

a swim monitoring station configured to wirelessly communicate with the one or more wearable alarm devices, the swim monitoring station in wireless communication with the pool alarm, the swim monitoring station switchable between an off state and an on state;

wherein:

when the swim monitoring station is switched from the off state to the on state, the swim monitoring station is configured to send a wireless signal to the pool alarm to automatically switch the pool alarm from the activated state to the deactivated state; and

when the swim monitoring station is in the on state and detects a triggering event associated with the one or more wearable alarm devices, the swim monitoring station is configured to send a wireless signal to the pool alarm to automatically switch the pool alarm from the deactivated state to the activated state.

5. The system of claim **4**, wherein the swim monitoring station is configured to receive an input and, in response, switch from the off state to the on state.

6. The system of claim **5**, wherein the swim monitoring station comprises a user interface configured to receive the input from a user.

7. The system of claim **4**, wherein the swim monitoring station is adapted to releasably hold the one or more wearable alarm devices.

8. The system of claim **7**, wherein the swim monitoring station is in the off state when each wearable alarm device is held by the monitoring station.

9. The system of claim **7**, wherein:

each wearable alarm device is configured to send a connect signal to the swim monitoring station; and

the swim monitoring station is configured to switch from the off state to the on state when one of the wearable alarm devices is removed from the swim monitoring station and sends the connect signal.

10. The system of claim **4**, wherein at least one of the pool alarm and the swim monitoring station is switchable to a safe mode, wherein, in the safe mode, the swim monitoring station is not switchable from the off state to the on state and/or the pool alarm is not switchable from the activated state to the deactivated state.

11. The system of claim **4**, wherein:

each one of the pool alarm and the swim monitoring station is configured to receive a periodic signal from the other one of the pool alarm and the swim monitoring station; and

the pool alarm is not switchable from the activated state to the deactivated state when the periodic signal is not received at one of the pool alarm and the swim monitoring station.

12. The system of claim **11**, wherein the pool alarm automatically switches from the deactivated state to the activated state when the periodic signal is not received at one of the pool alarm and the swim monitoring station after a predetermined period of time.

13. The system of claim **4**, further comprising at least one camera at the pool.

14. The system of claim **13**, wherein the camera is configured to capture photographs and/or video, and wherein the camera or a controller associated therewith is configured to send video feed signals and/or multimedia messaging service (MMS) messages to one or more outside devices.

15. The system of claim **14**, wherein the one or more outside devices include one or more video monitors and/or mobile communication devices.

16. The system of claim **14**, wherein the camera or a controller associated therewith is configured to send video signals and/or MMS messages to the one or more outside devices when the pool alarm is in the activated state and an entrance into the pool and/or movement in the pool is detected.

17. The system of claim **14**, wherein the camera or a controller associated therewith is configured to send video signals and/or MMS messages to the one or more outside devices when the swim monitoring station is in the on state.

18. The system of claim **14**, wherein the camera or a controller associated therewith is configured to send video signals and/or MMS messages to the one or more outside devices when the swim monitoring station is in the on state and an alarm condition associated with one of the wearable alarm devices is detected.

19. The system of claim **13**, further comprising at least one light source, the light source configured to illuminate the pool area while the camera captures photographs and/or video.

20. The system of claim **19**, wherein at least one camera and/or at least one light source is positioned and configured to provide video and/or MMS messages from below a water surface of the pool.

21. The system of claim **13**, wherein the camera is configured to detect motion or movement around the pool and/or below a water surface of the pool, and wherein the camera or a controller associated therewith is configured to send a signal to activate the pool alarm when motion or movement is detected and then not detected for a predetermined period of time.

22. The system of claim **4**, wherein at least one of the pool alarm and the swim monitoring station is configured to send short message service (SMS) messages to one or more mobile communication devices.

23. The system of claim **22**, wherein the SMS message(s) are sent when the pool alarm is in the activated state and an entrance into the pool and/or movement in the pool is detected.

24. The system of claim **22**, wherein the SMS message(s) are sent when the swim monitoring station is switched to the on state.

25. The system of claim **22**, wherein the SMS message(s) are sent when the swim monitoring station is in the on state and an alarm condition associated with one of the wearable alarm devices is detected.

26. The system of claim **4**, wherein at least one of the pool alarm and the swim monitoring station is configured to autodial one or more telecommunication devices and play a prerecorded message.

27. The system of claim **4**, wherein the pool alarm is configured to automatically switch from the deactivated state to the activated state when the swim monitoring station is in the on state and a predetermined period of time has elapsed without the swim monitoring station having received a wireless signal from at least one of the one or more wearable alarm devices.

28. The system of claim **4**, wherein the pool alarm is configured to detect a level of movement of water in the pool, and wherein the pool alarm is configured to automatically switch from the deactivated state to the activated state when the swim monitoring station is in the on state and a predetermined period of time has elapsed without the swim monitoring station having received a wireless signal from at least one of the one or more wearable alarm devices indicating that the at least one wearable alarm device is moving and/or wet.

29. The system of claim **4**, wherein the pool alarm is configured to detect a level of movement of water in the pool regardless of whether the pool alarm is in the activated or deactivated state, and wherein the pool alarm is configured to automatically switch from the deactivated state to the activated state after a predetermined period of time has elapsed without detection of the level of movement of the water in the pool.

30. The system of claim **4**, wherein the pool alarm comprises at least one sensor directed toward a perimeter of the pool and/or toward an entrance of the pool.

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